PILOT MODULES OF OPESS – AN ONLINE COURSE ON OPERATIONS MANAGEMENT, ERP- AND SCM SYSTEMS

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Abstract — *The project OPESS, financed by the Swiss Virtual Campus program, aims at achieving an integrated approach to Web Based Training in the field of Operations Management. Special consideration is given to questions of managerial and technical concepts and to related software solutions that have gained great significance worldwide as Enterprise Resource Planning (ERP) and Supply Chain Management (SCM) systems. This paper will present the concepts used for the design and the development of the OPESS pilot modules and examples taken from these modules.*

Index Terms — *Operations Management, e-learning, Inventory management, Just-in-time, Scheduling.*

INTRODUCTION

A sound understanding of operations management is of great importance for today's students who will later be taking over managerial responsibilities in manufacturing as well as service enterprises. In today's competitive environment, success is determined less by traditional advantages - linked to technology or quality - than by the performance of logistic networks. Successfully designing, organizing, planning and running complex systems such as these, which are particularly prone to time-related or geographic variability, requires a scientific approach and a fundamental understanding of the phenomena that control them.

PROJECT DESCRIPTION

OPESS (for Operations management ERP and Supply chain management System) is a project of the Swiss Virtual Campus program which aims at developing e-learning material for under-graduate and graduate courses in the Swiss universities.

Project goals

The OPESS project devoted to Operations Management has several objectives :

- **Increase the activity of the learner:** With the premise that we learn better and more efficiently when we are active than when we are passive (i.e. listening to the lecturer), several levels of interactions are proposed to the learner:
  a) interactions with the material by clicking buttons or making use of hypertext features; by taking decisions on which part of the material to see next, (more information on a given subject or visualizing a figure etc. receptive learning).
  b) interaction with the content through quizzes or through the manipulation of input data of animated diagrams.
  c) interaction with the teacher when the learner is asked to formulate and pose questions or opinions. The teacher will receive those by email and can send a corrective feedback.
  d) interaction with the knowledge community when the learner is required to look for information on the web
  e) interaction with other learners in chats when collaborating through the learning environment is required to solve a problem

  This objective is highly dependent on the motivation of the students and must then be addressed correctly.

- **Use course period and teacher competences more efficiently**: When comparing the competences involved during the course through the teacher and the use that students make of the available knowledge and expertise, it appears that this time could be used more efficiently. Having an expert presenting subtleties of a theory, correcting misunderstanding, putting in relation distant elements of a complex knowledge body is of high value and will contribute actively to the success of a university. Thereafter spending face-to-face periods analysing cases and resolving questions, and thus making better use of the expertise of the teacher, puts the exchange at a more interesting level for both teacher and learners.

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The absolute necessity of learning the basic concepts and transferring the main content is then done through interactive e-learning material. But the success of such a strategy depends highly on the personal work of the students.

- **Create a synergy of competencies**: Each partner of this project brings with him his best practices on the subject matter, pedagogy, technology and all the interactions between these elements. This should result in a material with a large amount of added value in comparison to a book or to a classical lecture: modularity, interactivity, multi audience, pedagogically and thematically coherent.

Audiences

The OPESS material is preferentially developed for registered students of the first two levels (under-graduate and graduate) and for continuous education of experienced professionals with a university degree. The main characteristics of these audiences are briefly presented below:

- **Undergraduate level**. The learners of this audience, have usually only a reduced, if any, experience. They are strongly dependent on the teacher and their motivation is very heterogeneous. The interest of E-learning material is to provide them with an additional opportunity to get independence and learn how to learn.

- **Master level**. In this audience, some learners have already been confronted, through professional experience to a reality related to the course material, others not at all. Usually in this type of course, the learners come from different backgrounds with various degree of knowledge. Their needs and their demands can therefore be very heterogeneous. The interest is then to let each learner manage the pace of his/her study, spending more effort on some subjects and concepts in relation with his/her interest and need.

- **Continuing education** for private companies or public institutions. In this situation, e-learning material is an opportunity to deliver a knowledge "just in time" at the rhythm and the place at which it is required. The modularity is a key issue as this audience is very heterogeneous in background and expectation. Some students need a refreshment on all the subjects, some others need to fill a gap on a few specific points, while others have a good understanding of all the matter through their professional practice, but need to learn the formal concepts.

Project Management

The partners of the project are the Information System Institute (IWI) of the University of Bern, The Production and Robotics Institute (LGPP) of the Federal Institute of Technology EPF Lausanne, the Center for Enterprise Sciences (BWI) of the Swiss Federal Institute of Technology ETH Zurich and the Network for Logistic (IPLnet) of the Universities of Applied Science.

The collaboration of the several contributing partners emerged as a complex task concerning the project management. OPESS partners come from the French and the German speaking part in Switzerland. They have different pedagogical methodologies and teach in different institutes. Therefore there is an important challenge in getting coherence and agreement on pedagogical goals, pedagogical methodologies, module structure, modularity, presentation form, etc.

To answer to this challenge, the work has been organized in 3 levels:

- 3 development teams, each one responsible of the development of 8 modules. Each group is managed by a project leader.

- 1 expert committee composed with one person of each group. This committee has monthly meetings for evaluating technical and pedagogical and proposing solution to the steering committee.

- 1 steering committee constituted by the 3 professors responsible of the project. They meet every two months with all the partners in plenary sessions where decisions are taken.

Content of Opess

OPESS covers material belonging to the field of production and operations management. Production and operations management is the process of managing people and resources in order to create a product or a service. Operations involve the logistics required to support the production function. "The term operations management refers to the systematic direction and control of the processes that transform inputs into finished goods and services"[1] .

FIGURE 1

OPESS STRUCTURE AND MODULES

The OPESS material aims at addressing issues ranging from the strategic to the execution levels of operations management. The course content is therefore structured into three sections: strategic planning, operational planning, and control and execution. Each section contents several modules as indicated in Figure 1.

To ensure that students don't have to handle the subject of operations management only on a theoretical level, examples, case studies, and videos of real-world applications in manufacturing and service industries are embedded.

PEDAGOGICAL CONCEPTS AND GUIDELINES

Learning over the Web demands different pedagogical and didactical ways for the orientation and the navigation of the students. The previous knowledge of the students has absolutely to be taken into account. Another important point to address is the student's motivation.

We want to present here the pedagogical concepts that are used in OPESS.

The Pedagogical Triangle

As presented in figure 2, the learning-teaching process occurs in a situation with 3 poles (student, lecturer, knowledge) [2]. What is known from experienced teachers is that usually a specific pedagogical action takes place only on one side to the detriment of the forgotten pole which became often the "dead" of the situation. In e-learning, the main risk is obviously to let the student alone with the material, totally neglecting the lecturer's contribution. This issue has been particularly taken into account during the development of the OPESS modules, in order to avoid this pitfall. The pedagogical scenarios presented at the end of this paper have been designed in that sense.
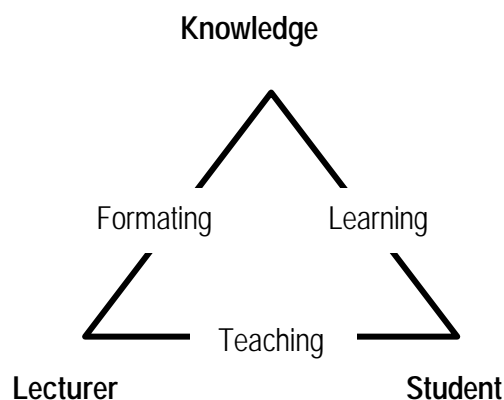
Knowledge

Formating   Learning

Teaching

Lecturer   Student

FIGURE 2

PEDAGOGICAL TRIANGLE

The Objective Taxonomy

The **objective taxonomy** was used as a guideline to select the different e-learning elements in accordance with the learning objectives. The original Bloom taxonomy [3] has been changed to be adapted to business and engineering. Then the learning objectives ordered by growing performance are:

- **To know,** meaning that when this objective is obtained the learner remembers names, standards, dates, reference numbers etc. This objective depends mainly on the memory and classification, and it is by reading and listening that the learner can reach it.

- **To understand,** refers to the ability of organising elements of a situation, of a model in a meaningful manner. It includes also the ability to classify factors of a situation in causes and effects, and to be able to explain the mechanism ruling the situation with own words. This objective is reached when the learner re-builds the theory in his mind. For this purpose, diagrams and dynamic models, allowing the user to observe the effect of variable input data on the output are important resources.

- **To apply,** refers to the ability to use his knowledge to solve a practical situation. By solving problems and cases the learner can train this ability.

- **To manage,** refers to the ability of supervising other persons when specific knowledge is required to act adequately. Then this means being able to explain how things work as well as any necessary consideration related to efficiency, security, quality. A way to develop this type of ability is the use of case studies.

Figure 3 indicates the relation established between the various elements of the e-learning material and the learning objectives presented in the previous paragraph:

- **Motivation** must be present in all the material, encouraging the learner in his progress. This can be done by presenting the advantages of the knowledge he/she is integrating, presenting the control over systems that he/she will gain and foster his interest to consult other sources and to try by himself. There are different types of motivation and every learner has his/her own blend (getting experience, understanding how things work, solving a practical problem etc..). It is therefore important that the motivation stays diverse. In short, it is important to tell the students why this knowledge is interesting for them, taking into account that their interests are diverse.
  In the OPESS material, a part at the beginning of each module constitutes the motivation of the subject in itself. This part exposes why the particular module is important for operations management.

- The **concept exposition** is the most classical part of learning material. The specificity of e-learning material

is to offer the possibility to include animations, hyper text resources and interactions. The animation in this part is not only a style effect but gives also the possibility to keep the learner attentive and active.

- The **quiz** elements can be embedded in the concept presentation to produce reflexive pauses and trigger learner's reflection. It can also be used as a self-assessment at the end of the module to let the learner determine what he/she has retained from his/her study.

- The **model** elements are interactive diagrams that let the learners play with the constitutive elements or quantities of a system. The models are puzzles that trigger the reflexive observation and "what if" analysis. With these elements learners can become familiar with equations and understand how outputs vary when inputs are changed.
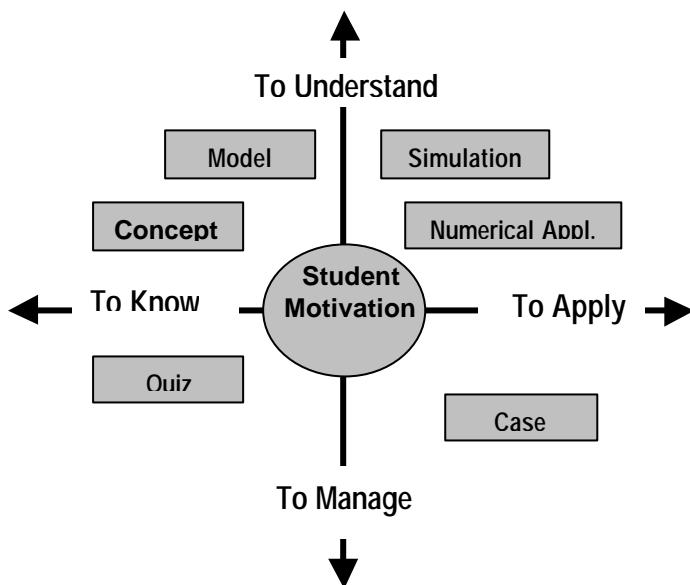
FIGURE 3

USE OF DIDACTICAL ELEMENTS REFERRING TO THE DIFFERENT LEARNING OBJECTIVES

- **Numerical applications** offer a large range of possibilities. They can be examples illustrating the application of a specific knowledge in a given situation. They can be application exercises requiring from the learners to apply the exposed knowledge in a specific situation. They can as well be assessment elements to check what the learner has understood.

- **Simulation** refers to games that simulate a real situation. In such a game (as the Beer Distribution Game) the learner is asked to apply his knowledge to a complex dynamic situation. A key element is the interaction with other players (this role can be assumed by a computer). Usually also the complexity of the situation forces the player to take decisions that, balancing competitive phenomenon, interests and limits, tend to simulate the decision process of the real world.

- **Case Studies** refers to different types of activities based on a practical situation and aims at developing the ability for analysing and controlling situations as required in managerial responsibilities.

Pedagogical Scenarios

The e-learning material developed within OPESS must serve as a base for use in several teaching situations. As such, it can be considered as a document base from which the teacher can select the relevant documents needed to construct a specific course. The different scenarios considered are:

- **Scenario 1, course companion**: in this scenario the teacher gives his course as a usual lecture and refers the learner to the e-learning material as a course companion where more extensive explanations and interactive elements can be found as complementing study material. In that situation, the gain would be principally on the quality of learning .

- **Scenario 2, content delivery**: In this scenario the learner gets the content of the course through the e-learning material. He/she is required to study the subject before the "lecture" which consists then in answering questions that each student has to pose before the lesson. The advantage of this scenario is that the teacher has the role of an expert of the subject who can focus his interaction with the student on key points particularly difficult for them. He has also a direct feedback of the level of understanding. An advantage of this procedure is the development of autonomy by the students. With such a scenario it is possible to diminish substantially the number of course hours and/or to integrate dynamical exercises, case discussions in which the interaction between learners is fostered, triggering thinking, understanding and motivation.

- **Scenario 3, levelling opportunity:** this scenario is very useful for master level courses and continuing education when students come from very different professional horizons and can have knowledge gaps that risk jeopardizing all the benefit of a course that is usually very concentrated in time. Then to allow the students to compensate their knowledge gaps, e-learning materials in which they can assess their current knowledge is put at their disposal. Therefore the students can study in priority parts of the material that correspond to their needs. This scenario could substantially improve the quality of continuing education.

- **Scenario 4 self learning material:** in this case, the learner studies at home and interacts with the teacher through e-mail. Depending on the learning contract, he/she can choose his/her proper rhythm and geographic independency.

TECHNICAL ISSUES AND IMPLEMENTATION

OPESS is one of the first e-learning projects that use XML technology to generate an online course. The decision for XML was taken for two main reasons:

- A strict distinction between course content and its representation allows cross-platform publishing (e.g. web sites as well as handouts) of the learning material, which is a pre-requisite for its re-use in other contexts.
- It eases collaboration since partners can choose any XML editor and – using the developed DOC2XML tool – even Word to create content. A common style sheet applied to the XML documents guarantees a consistent layout and presentation.

The valid syntax of an XML document is defined in a so-called Document-Type-Definition (DTD). For OPESS the Learning Material Markup Language (LMML) was chosen as a DTD. It has been developed at the University of Passau (http://daisy.fmi.uni-passau.de/pakmas/lmml/) and can describe structure, content and media of an online course. The content is organized in modules, which eases its re-use by their re-combination.

Macromedia Flash was also extensively used within OPESS. Flash elements are interactive, vector- as well as bitmap-oriented animated graphics for online-use. With a training of about two days people with basic programming knowledge are able to generate Flash elements. The technology is limited when it comes to server-client interaction. For server-generated content (which is necessary for simulations with more than one student taking part, e.g. the Beer Distribution Game, (http://www.beergame.lim.ethz.ch) Java is a better choice.

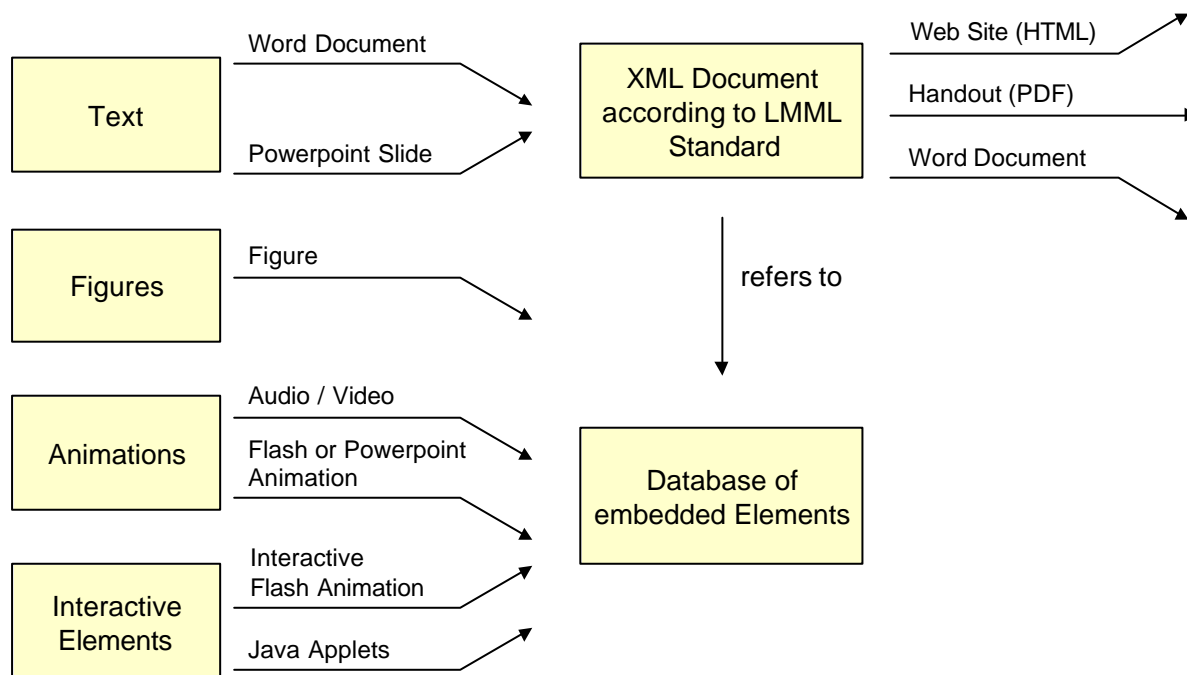Figure 4 presents the production process of the OPESS material.

FIGURE 4

USING XML TO DESCRIBE COURSE CONTENT

Scenario script

The scenario script is a simple tool consisting of a table indicating

- the specific subject,(corresponding to all the elements of the syllabus)
- the objective in terms of development of the learner's ability ,
- the taxonomy level
- the activity of the teacher,
- the activity of the learner,
- the time it should take for the learner,
- the interactive element to be developed

This script is very useful for beginning the development, negotiating the content with the different partners involved and evaluating the effort necessary for the development of the material.

Interactive elements

Here are some examples of interactive elements developed in the pilot phase:

- **Animations** are animated presentations of concepts in which the learner observes a set of comments and figures strongly related through a logical sequence that aims at facilitating understanding. In this manner concepts with a relative complexity such as the ABC analysis or the service level are presented. These animations look like MS Powerpoint animations.
- **Drag and drop** elements are used as a type of puzzle requiring from the learner to drag graphical elements and drop them into the appropriate place. We use this type of element , for example, when asking the learner to discriminate between different types of costs and to make a small classification of different models of inventory management.
- **Game** elements are used to confront the learner with a model of reality in a type of active experimentation. In the pilot module a small game of inventory was developed, in which the user is asked to maximize profit by choosing the level of initial stock in a simple production line and a version of the Beer Distribution Game.
- **Diagram** elements are used to let the learner play with elementary models. In a classical text book, these models are introduced through equations and graphs. The opportunity of e-learning material is to let the learner change the values of the input parameters and discover by itself how the model will react by seeing how a curve or a numerical result is changed.

CONCLUSIONS

The new technologies of information and communication offer interesting opportunities to produce dynamic didactic material that can be adapted to different types of audience.

Nevertheless E-learning involved a complex technology, demanding sophisticated competences and infrastructure. The development and maintenance of the material is also very demanding in time.

A lot of effort as been dedicated to reach agreements on pedagogical and technical issues with the idea of producing an interesting material of Operations Management, suitable for the target audiences and as easy as possible to customise and maintain.

The difficulties that arise during the pilot phase where related to the parallel development of the technological solution and of the content, the broad range of competences to be involved and the complexity of the technological solutions.

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